Chapter 7

Occupational Health and Safety

Whether you work as a technician or an installer, your work with optical fibre can expose you to several workplace hazards. This includes the hazards ranging from laser light sources to ladders. Optical fibre technicians are responsible for their own safety as well as for the safety of their co-workers. Safety manual is prepared keeping in consideration the health of workers, their job holding efficiency, environment, etc., so that their job can be completed accurately and on time. Knowledge to incorporate safe work practices is necessary. This chapter describes the types of hazards that you will encounter while working with optical fibre. Some of the hazards are unique to optical fibre work, but others are more common. This chapter also discusses the dangers that these hazards create, and inform you of the different methods of working safely around them.

Basic Safety

Whenever you work in a hazardous environment, such as a construction site, a lab, or a production facility, you must always be aware of the potential dangers you face. Two guidelines to follow while working are: personal protective equipment (PPE), and good work habits.

Personal Protective Equipment (PPE)

Personal protective equipment consists of anything that you would wear to protect yourself from hazardous material or situations. They can include protective gloves, clothes and eyewear for cutting and grinding operations, respirators for working with chemicals that take out harmful vapours, and specialised goggles for working with lasers.

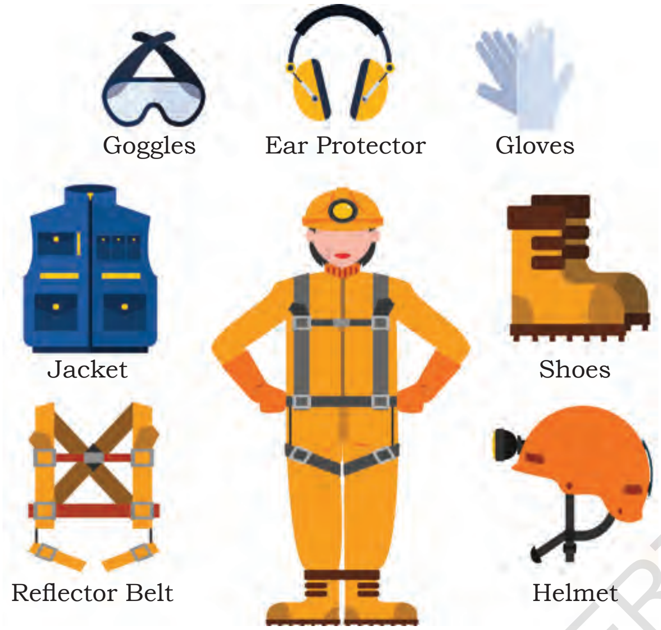


Fig. 7.1: Worker with safety equipment

The PPE protects you not only from short-term accidents, such as cuts or flying shards of glass, but also from damage that can accumulate over time. Such damage may include dust from construction operations, such as drywall sanding that can build up over time in your lungs and cause diseases such as silicosis, or exposure to chemicals such as solvents that can have harmful long-term or chronic effects as well as harmful short-term effects. While using the PPE, inspect it carefully to ensure that it is in good condition. Look for cuts, tears, or other signs of damage in protective outerwear such as gloves or aprons.

Workers must wear safety equipment, e.g., safety helmets, glasses, ear and eye protection, protective clothing, high visibility vests, etc., as shown in Fig. 7.1 in designated areas, while working on specific jobs, and as per the directions of the supervisor for a specific purpose. Safety footwear must be worn at the work area. Any persons found not following the rules are asked to leave the site. Before performing any task proper training is provided to the workers. They should not handle any equipment without having complete knowledge of all tools and accessories and proper safety instructions are provided to the workers to complete the task. To work with machinery equipment proper qualification and training is needed.

Safety helmets

Safety helmets as shown in Fig. 7.2 must be worn by all workers at all times in all designated areas. It protects the worker from being hit by any falling material or other objects. Helmets should be replaced after three years from the date of issue if it has been used regularly. The date of issue must be recorded. The date of issue isn't the same as the date of manufacturing.

Fig. 7.2: Safety helmet

Eye and face protection

Never look directly at the fibre light, since it will damage the retina of the eyes. LASER light is a focussed beam and will penetrate inside the eyes causing blindness as shown in Fig. 7.3. Hence, it is important to wear goggles/ safety glasses for protecting eyes as shown in Fig. 7.3.

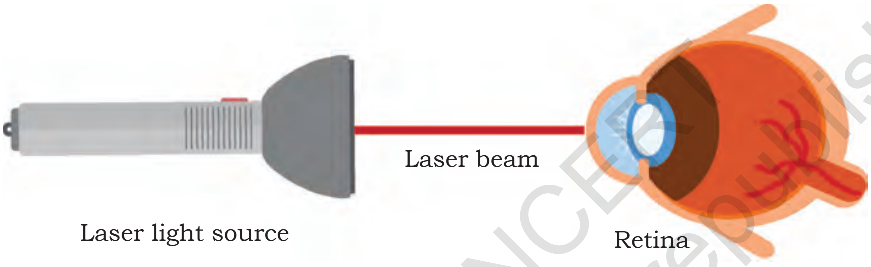


Fig.7.3: Protection of eyes against LASER light

As part of the termination and splicing process, you will be continually exposed to small scraps of bare fibre, cleaved off the ends of the fibres being terminated or spliced. These scraps are very dangerous. If they get into your eyes, they are very hard to flush out and will probably lead to a trip to the emergency room at the hospital. Whenever you are working with fibre, it is necessary to wear safety glasses.

Fig. 7.4: Safety glasses or goggles

Fig. 7.5: Respiratory or dust masks

Respiratory protection

Respiratory or dust masks as shown in Fig. 7.5 are to be worn when carrying out tasks that create inhalable dust or fumes, while handling certain chemicals or when working in dusty environments.

Clothing

Do not wear loose clothes as shown in Fig. 7.6. Loose clothes like un-tucked T-shirt, a belt, an unbuttoned jacket or even loose shoelaces, can be caught in the moving machinery. Hence avoid wearing these types of clothes.

Fig. 7.6: Loose clothes

Footwear

Boots must be worn at all times on site as shown in Fig. 7.7. A steel-toe boot (also known as a safety boot, steel-capped boot or safety shoe) is a strong boot or shoe that has a protective strengthening in the toe which protects the foot from falling objects.

Gloves

Safety gloves of appropriate protective material as shown in Fig. 7.8 are to be worn when handling sharp or hot material, chemicals, or dangerous liquids.

Fig. 7.7: Footwear

Fig. 7.8: Hand gloves

Keep all food and beverages out of the work area. If fibre particles are ingested they can cause internal damage to your stomach. Hence, wear laboratory coat as shown in Fig. 7.9 or disposable apron to minimise fibre particles on your clothing. Fibre particles can become lodged in clothing and can later get into food, drinks, and/or be ingested by other means. A coat also ensures that laboratory chemicals do not harm the clothing.

Fig. 7.9: Safety jacket

Good work habits

Good work habits are in some ways the simplest and most effective means to working safely. Good work habits can help you prevent accidents and spot potential problems in time to correct them. Here are some general rules for working safely.

- Keep a clean workspace. Clean up at the end of your work day and store tools properly.
- Observe your surroundings. Look up from what you are doing once in a while to make sure everything around you is the way it should be.
- Use tools for the job they were designed to perform. Misuse of tools is one of the most common causes of accidents in the workplace.
- Do not eat or drink in the work area. In addition to accidentally drinking from the wrong bottle, you could accidentally ingest glass fibre or other dangerous materials that might get mixed with your food.
- Report problems or injuries immediately. Let your facility supervisors know about hazards so they can correct them as soon as possible.
- Know how to reach emergency personnel. Have emergency numbers posted by the nearest telephone so you don't waste time searching through a directory in an emergency.
- Jewellery such as watches, rings, bracelets, earrings and necklaces are not permitted in work areas.

Fig. 7.10: Insulated tools

- Do not touch your eyes or mouth while working with fibre optic systems until your hands have been thoroughly washed.
- All tools and equipment not being used must be safely stored. Always use insulated tools while working. The typical insulated tools are shown in Fig. 7.10.
- Put all cut or broken fibre pieces in the dust-bin for disposal. All rubbish and waste should be put in waste bins located on site. Do not drop them on the floor where they will stick on carpets or to shoes and be carried elsewhere.
- Thoroughly clean your work area when you are done. Use adhesive tape to pick up any broken fibre pieces from surfaces to ensure no one rests on them or step onto them.
- Check the weather report. When working outside, make sure that the person works in clear weather conditions as shown in Fig. 7.11. If weather is not favourable, like presence of black clouds in the sky or a thunderstorm then wait for the weather condition to become normal.
- Watch for signs of a coming storm. Regularly monitor the changes in temperature, increase in wind, or darkening of the sky as shown in Fig. 7.12. If it looks like a storm rolling in, cover the panel and stop the work. Look for shelter immediately.

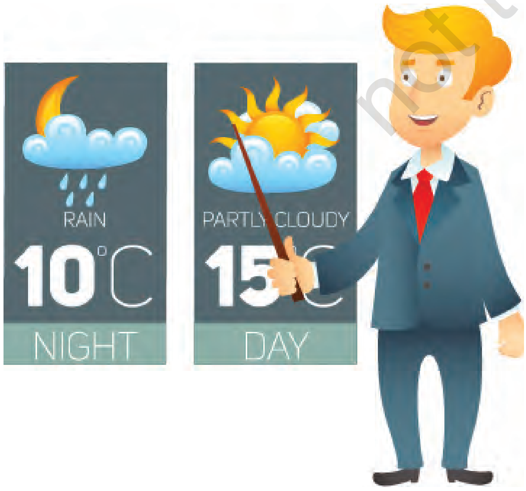


Fig. 7.11: Checking of weather report

Fig. 7.12: Watch for signs of a coming storm

Concepts of LASER light safety

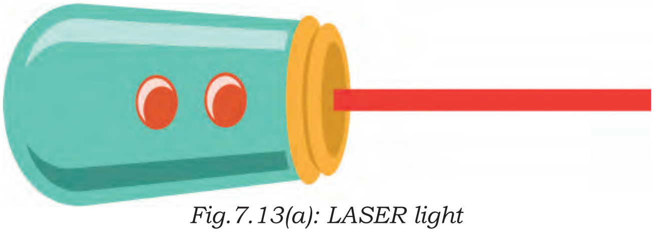


Fig.7.13(a): LASER light

The use of laser light emission by industry and by the academic community continues to increase. A laser can be especially dangerous because it can concentrate a great amount of power into a small beam of coherent light. Many lasers used in optical fibre operate below dangerous levels, but some, such as those used for transmission over long distances, put out enough power to cause damage in a very short time. These should only be used with proper eye protection or measuring devices to prevent eye damage. The hazard evaluation procedure used is based on the ability of the laser beam to cause biological damage to the eye or skin during intended use. It is related to the classification of the laser or laser system from Class 1—considered to be non-hazardous, to Class 4—very hazardous.

Eye hazards

Certain areas of the eye absorb more light. Absorption of laser radiation above a certain level leads to tissue injury.

Class 1

No hazardous level of optical radiation (exempt lasers) under normal operating conditions must be emitted. Included in this category is laboratory equipment using lasers with all beam paths and reflections, etc.

Class 2

Low-power visible laser device of 1 milliwatt does not have enough output power to injure a person accidentally, but may injure the eye when stared at for a long period. A 'caution' label must be placed on the device. These lasers are used for alignment procedures and optical experiments.

Class 3a

Laser rated between powers of 1 milliwatt to 5 milliwatts cannot injure a normal person when viewed with unaided eye, but may cause injury when the collected energy is the eye as with binoculars. Most laser pointers fall into this category. A danger or caution sign must be put on the device, depending on its irradiance.

Class 3b

Laser rated between 5 milliwatts to 500 milliwatts can produce eye injury when viewed without eye protection. This class of laser requires a danger label and could have dangerous reflections. Eye protection is thus required.

Class 4

Lasers rated above 500 milliwatts in power can injure you if viewed directly or by viewing both the specular and diffuse reflections of the beam. A danger sign will label this laser. These lasers can also present a fire hazard. Eye and skin protection are required.

Safety rules while using lasers light

1. Avoid looking directly into any laser beam or at its reflection.
2. Remove all unnecessary specular (shiny) reflecting surfaces from the work area.
3. Operate lasers in well-defined areas to which access can be controlled. The area should be posted with appropriate signs to alert persons passing by the area that a potential hazard exists as shown in Fig. 7.14(b).
4. The laser system should be operated only by or under the direct supervision of a person knowledgeable of the hazards and control methods

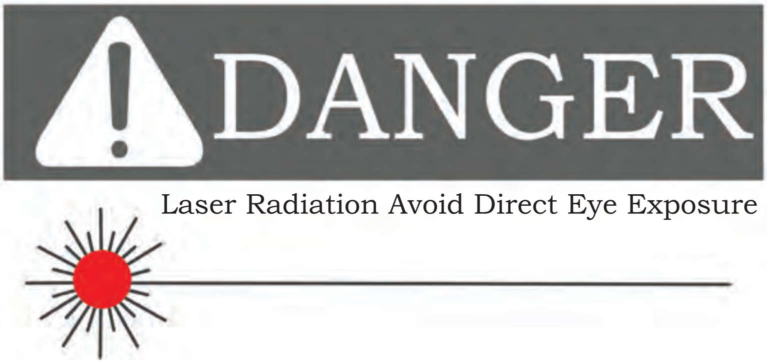

DANGER
Laser Radiation Avoid Direct Eye Exposure

Fig. 7.13(b): Sign and alert from the hazards due to LASERS for both beam and non-beam conditions. This individual is usually the laser safety officer (LSO) who is designated by the administration of the company, hospital, or educational institution.

5. Any accident should immediately be reported to the responsible medical authority.

Site safety

Many of the locations for fibre optic components may be in areas that require special safety precautions. These may include construction sites, enclosed areas, locations near high-voltage power lines, or areas requiring access by ladder. Always follow the on-site safety requirements and observe all warning signs. Here are some general safety rules to help you.

Electrical

When fibre optic systems run through the same area as electrical wiring or cabinets, use extreme caution with tools and ladders. One wrong move can send enough voltage through your body.

Fire safety

Note that fusion splicers use an electric arc to make splices, so care must be taken to insure no flammable gases are present in the space where fusion splicing is done.

Fire extinguisher

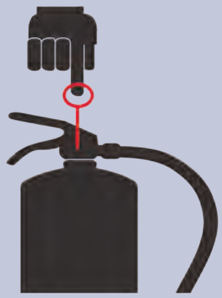
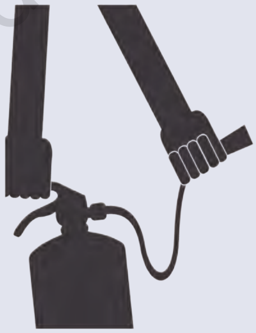
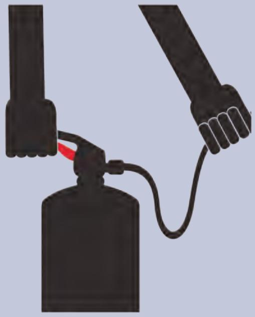
A fire extinguisher is a fire protection device used to stop the fire and burning (Fig. 7.14). It is the basic first aid equipment which can be effectively used for the fire control. It is a cylindrical pressure vessel containing an agent which can be liquidated to stop a fire. Always keep a fire extinguisher ready for the areas where person work with electrical equipment.

All the rooms were fibres are used must have fire and emergency exits in case of emergency use at all times.

Fig. 7.14: Fire extinguisher and its parts

More to know

The following steps demonstrate to operate a fire extinguisher in case of a fire emergency as shown in Fig. 7.15. Steps to open the seal and safety pin.

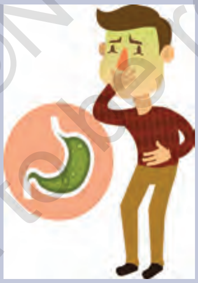
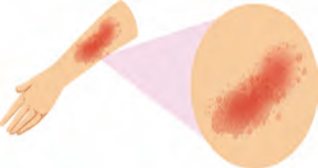
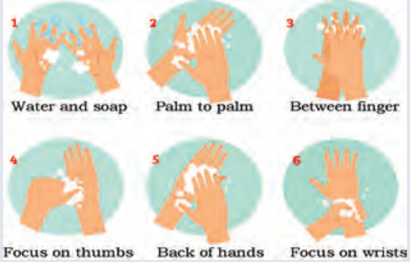
Step 1	Identify the safety pin of the fire extinguisher which is generally present in its handle.	 *Fig. 7.15 (a)*
Step 2	Break the seal and pull the safety pin from the handle.	 *Fig. 7.15 (b)*
Step 3	Use the fire extinguisher by squeezing the lever.	 *Fig. 7.15 (c)*

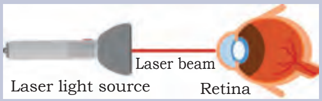
Safety of materials

Fibre optic splicing and termination use various chemical cleaners and adhesives as part of the process. Normal handling procedures for these substances should be observed. Always work in well-ventilated areas. Avoid skin contact as much as possible, and stop using chemicals that cause allergic reactions. Even simple isopropyl alcohol, used as a cleaner, is flammable and should be handled carefully.

More to know: Primary treatments for exposure to Isopropyl alcohol used to clean fibres or cables are presented in Table 7.1.

Table 7.1: Primary Treatments for Isopropyl Exposure

Type of exposure	Isopropyl Effect of exposure	Emergency treatment
Inhalation *Fig. 7.16: Inhalation*	Irritation of upper respiratory tacks *Fig. 7.17: Irritation*	Move victim to area containing fresh air. Administer artificial respiration if breathing is irregular. *Fig. 7.18: Artificial respiration*
Ingestion *Fig. 7.19: Ingestion*	Nausea, Vomiting  *Fig. 7.20: Vomiting*	Have victim drink water and milk. Seek medical assistance. *Fig. 7.21: Drinking water*
Contact with skin  *Fig. 7.22: Contact on skin via chemical*	Skin Irritation *Fig. 7.23: Irritation*	Wipe off the affected area of skin and wash with the soap and water.  1 Water and soap 2 Palm to palm 3 Between finger 4 Focus on thumbs 5 Back of hands 6 Focus on wrists *Fig. 7.24: Washing of the hands*

Contact with eyes  *Fig. 7.25: Laser contact with eyes*	Eyes Irritation *Fig. 7.26: Eye Irritation*	Wipe eyes with plenty of water for 15 min. *Fig. 7.27: Washing of the eyes*

Seek Emergency treatment for inhalation, ingestion, severe contact with skin, and contact with eyes.

Safety from bare fibre

The broken ends of Fibres and scraps of Fibre created during termination and splicing can be extremely dangerous. The ends are extremely sharp and can easily penetrate your skin. They invariably break off and are very hard to find and remove. Sometimes a pair of tweezers and perhaps a magnifying glass will get them out. Be careful when handling fibres to not stick the broken ends into your fingers. Dispose of all scraps properly in a yellow sharps bin. Do not drop Fibre scraps on the floor where they will stick in carpets or shoes and be carried elsewhere like home. Also, do not eat or drink anywhere near the work area. Fibre scraps can get into food or drink and be swallowed.

Documenting the activity assemble

Documenting the activity assemble means to make the document which involves all the task, rules, safety method statements, policies of the government to be followed to come the activity, listing the hazards and necessary prevention steps to be taken against each task. The tasks which are to be carefully handled has to be listed carefully with rules listed step by step.

- Rate the risk in accordance with the risk matrix. Determine the level of risk and its preventions.

- Activity should be supervised, monitored and reviewed from time to time and ensure that it is documented properly.
- Sometimes documentation requires changes, in which case, it should be revised accordingly.
- To proceed with a task, a written record of the process is to be used. It should be signed off by the parties who have responsibility for the tasks, as it is a record that can be used in court.

First Aid

All accidents and equipment damage which occurs at the job must be informed immediately, so that proper safety aid or repairing of machinery is required. First aid is of prime importance in the event of an accident. Hence, everybody should know the basic methods of first aid as shown in Fig. 7.25.

- Bring the affected person at peaceful and airy place, and care should be taken to avoid suffocation.
- Keep all the parts of body of affected person in straight position and should be laid down on an even spot.
- In case of head injury, lay down the affected person in such a way that the head rests in upward position.
- In case of trouble in proper respiration, the person should be kept in sitting position.
- In case of wounds, then take water in one small bucket and add 4 drops of Iodine in it to make it anti-bacterial, and wash the wounds neatly and carefully and dry it. Then apply the iodine on wounds and wrap it by medicated/antibacterial cotton.

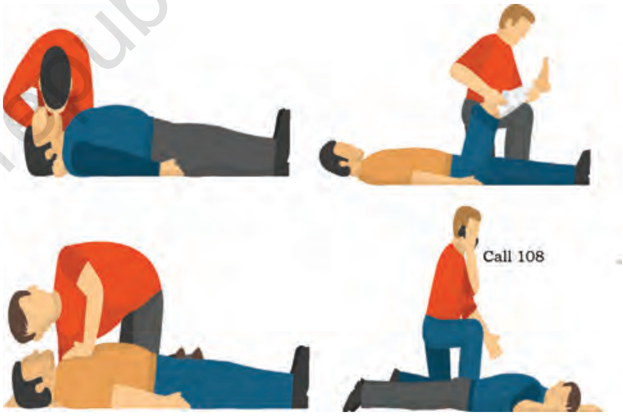


Fig. 7.25: Giving basic first aid

The following medicines/items should be kept in first-aid box—

(a) Small dressing cotton
(b) Medium dressing cotton
(c) Large dressing cotton

(d) Yellow or dressing pad for burn injuries
(e) Clean and sterilised cotton pads
(f) Tincture iodine
(g) Potassium permanganate
(h) Sol-violate spirit (for smelling of unconscious person)
(i) Adhesive plaster
(j) Eye drops
(k) Boric powder
(l) Tourniquet
(m) Three angle bandage (in case of broken bone)
(n) Safety pins
(o) Soda Bi-Carbon
(p) 2 or 3 wooden plaques
(q) Aspirin tablets
(r) Bottle of Dettol or Savlon liquid
(s) Bottle of spirit
(t) Scissor, knife, etc.

Bleeding

There can be four types of bleeding through injuries—

1. Minor bleeding
2. Bleeding through artery or main blood circulatory system
3. Bleeding from vein
4. Internal bleeding

Fig. 7.26: Lying unconscious

If bleeding is of (1) or (3) type, then first tightly wrap the part of body below and above the wound in order to stop the bleeding. Internal bleeding, from stomach, brain or lungs, etc., cannot be seen. However, it can be seen in the vomit or spit of injured person. Internal bleeding is more dangerous than external bleeding. In such situations, give the injured person cold water or ice and arrange for immediate medical help. Excessive bleeding after injury may cause death rather than bleeding from wounded spot. Hence, medical help should be arranged without any delay.

Check Your Progress

A. Multiple Choice Questions

1. Never look directly the fibre light, since it will damage the _____________.
   (a) retina of your eyes
   (b) ears
   (c) skin
   (d) nose
2. LASER light will penetrate inside the eyes retina causing blindness since it is _____________ beam.
   (a) focussed
   (b) unfocussed
   (c) scattered
   (d) transmitted
3. Which of the following is used to heal the burn injury in case of electrocution?
   (a) Burnol
   (b) Soframycin
   (c) Burnol or Soframycin
   (d) None of the above
4. Which of the following is not a type of bleeding?
   (a) Minor bleeding
   (b) Bleeding through artery or main blood circulatory system
   (c) Bleeding from vein
   (d) External bleeding
5. First aid box must contain _____________.
   (a) tincture iodine
   (b) potassium permanganate
   (c) sol-violate spirit
   (d) All of the above
6. What are the steps for using the fire extinguisher?
   (a) Identify the safety pin of the fire extinguisher which is generally present in its handle.
   (b) Break the seal and pull the safety pin from the handle.
   (c) Use the fire extinguisher by squeezing the lever.
   (d) All of the above
7. We use the fire extinguisher in case of _____________.
   (a) flood
   (b) electric shock
   (c) fire
   (d) burn injury

8. Which of the following is the safety items a technician must not have while working?
   - (a) Safety boots
   - (b) Gloves
   - (c) Helmet
   - (d) Belt

B. Fill in the Blanks

1. While working on electricity, the technician must wear ____________ gloves and shoes.
2. Keep stretching your arms, legs, neck and back while working to ensure that they are not ____________.
3. The unconsciousness due to electric shock may cause damage to his/her ____________.
4. If burn injury is due to ____________, it should be cleaned and washed by spirit.
5. Defective or inadequate insulation may result ____________.

C. State whether True or False

1. Fibre optic splicing and termination use various chemical cleaners and adhesives as part of the processes.
2. The broken ends of fibres and scraps of fibre created during termination and splicing can be extremely dangerous.
3. Fire extinguishers used for electrical fires will have a C, BC or ABC on the label.
4. Apply Burnol or Soframycin type of creams to the burnt part of the body of an electrocuted person and wrap the bandage.
5. All the parts of the body of an affected person should be kept in straight position and should be laid down on an even spot.
6. Fire extinguisher consists of a hand-held cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.
7. The rating and physical condition of the components and cable should be checked.
8. Common injuries that can be caused due to lifting heavy loads include back ache, neck strain, wrist sprain, back sprain, shoulder pain.
9. The aim of first-aid treatment is to cool down the affected area rapidly to minimise damage and loss of body fluids, and therefore reduce the risk of developing shock.
10. Fire extinguisher is used in case of an earthquake.

D. Answer in Brief

1. What are the factors that result in a hazard?
2. List out the various remedies to be taken in the workplace.
3. How will you protect yourself from electric shock in a lightning storm?
4. What are the precautions to be taken for preventing electric shock on the job?
5. List out the various items that must be in a first aid box.
6. What are the first aid treatments in case of burn injury?
7. Write down the steps for correct way of operating a fire extinguisher in case of a fire emergency.

NOTES